TURKEY—OIL SPILL RESPONSE FOLLOWING AN EARTHQUAKE

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ABSTRACT: *This paper provides an overview of the incident at the Tupras Oil Refinery in Izmit, Turkey following the August 1999 earthquake, including the scenarios encountered and lessons learned. Oil spill operations are not simply confined to "at-sea incidents" and can be situated within areas of complete devastation, where priority for the cleanup of leaking oil is simply an afterthought. A good example of this would be Kuwait during the Gulf War and the strategic destruction of the oil fields.*

The earthquake

At 0302 (local time) on August 17, 1999, a major earthquake occurred in northwestern Turkey. The tremors lasted for 45 seconds and reached 7.8 on the Richter scale. Situated nearest to the epicenter of the earthquake was Izmit, a densely populated industrial city. In that short space of time, the death toll rose to approximately 17,000 people, plus 44,000 people injured. Over 300,000 homes had collapsed or suffered severe structural damage, with more than 400,000 business premises similarly affected (Figure 1). The Turkish government declared a state of national emergency, broadcasting a request for international assistance.

Figure 1. Earthquake damage adjacent to Tupras Refinery, Izmit.

Tupras Oil Refinery in Izmit, Turkey

Tupras is the state-run oil company and operates four refineries within Turkey producing 86% of the country's petroleum products, and the remaining 14% being produced by BP Amoco and Shell in southern Turkey. The refinery in Izmit is located in northwest Turkey and lies 80 miles southeast of Istanbul on the Sea of Marmara. This refinery is the largest crude oil processing facility in Turkey and accounts for 35% of Turkey's natural gas supplies, with 30 storage tanks holding over 7 million barrels of crude oil, this plant produces over 226,000 oil bpd (barrels per day).

The Izmit oil refinery was built in 1961 under the supervision of U.S. structural engineers. The building practices carried out during its construction possibly contributed to the zero death toll when the earthquake struck. According to an U.S. geological survey conducted in 1999, the earthquake occurred along one the world's longest and best-studied strike slips (horizontal motion) fault lines—the East-West North Anatolian fault. These fault slips are estimated to be up to 4.9 meters, and Izmit lies along this fault.

The earthquake's impacts on the oil refinery in Izmit. As the tremor occurred, the refinery suffered severe structural damage; however, the main problem to the refinery was the collapse of a chimney. The chimney struck an adjacent oil storage tank and processing facility, and generated a fire, which quickly got out of control and engulfed the tank farm.

The firefighting system within the refinery was inoperable because of lack of pressure and damage sustained to the firemain. The fire quickly spread to the tank farm and threatened adjacent industrial facilities including a fertilizer factory holding over 8,000 tons of highly flammable ammonia. On-site firefighting was overstretched, and international support was provided in the form of water bombing aircraft and helicopters delivering fire suppressants. Tugs normally employed in berthing tankers at the marine terminal were employed to supply alternative water supply. Utilizing their firefighting pumps onboard, the tugs provided firefighting water to combat the tank farm blaze.

Storage tanks at the tank farm are surrounded by a "bund" (in this case an earth made wall), which contains any leakage or spillage of product. As the firefighting effort continued with combating the blaze and boundary cooling adjacent tanks (Figure 2), the high volumes of oily water liquid began to spill into the oily water drainage system; this then flowed to the oil water separators. These were a series of holding ponds and API separators designed to deal with the small quantities of oil normally found in surface runoff water. In this case, the volumes of water and oil were too much for the separator system to handle. The runoff overwhelmed the separators, and the oil was released into the bay leading to a spill. The spill may have been controlled easily if personnel were available to manage the flows in the interceptors, but all available personnel were engaged in either firefighting operations or rescue missions. The disruption of the power supplies within the refinery also prevented the use of the refinery pumps to control the carryover into the outfall.

Figure 2. Boundary cooling of Tupras Tank Farm.

Response to the incident

The effects of the earthquake were immediately apparent to Tupras, which requested assistance from both BP Turkey and Shell. Both BP and Shell requested Oil Spill Response Limited (OSRL) to provide equipment and personnel to respond to the incident. Details of the precise circumstances surrounding the incident were scarce because of the collapse of the telecommunication infrastructure, and it was decided to dispatch OSRL's duty manager to the site to perform an on-the-spot assessment of the situation.

While the duty manager was in transit, Tupras began a series of overflights to assess the volume of oil at sea. Heavy patches of sheen were discovered and subsequently reported as heavy oil at sea. The observation was reported to OSRL, and a suitable response package of palletized equipment was identified quickly. Careful consideration was given to the type of response equipment required, accounting for factors such as oil type, location, and relevant coastline features, etc. On the evening of August 18, a team of 10 responders was placed on immediate priority call.

Prior to the OSRL team departing the United Kingdom, one team member was identified to fly with the equipment onboard the L382G Hercules aircraft. Loaded with shoreline response equipment and two additional pallets of inshore boom, the Hercules was flown to Istanbul International Airport. The equipment was then forwarded by road to the refinery.

The team was mobilized in the early hours of August 19 and was called into the base for a briefing before traveling to Turkey. On the morning of August 20, the equipment and personnel arrived at the refinery. The response team was escorted to the marine terminal and conducted risk assessments and site surveys to further assess the on-scene situation.

OSRL's policy during an incident is to pair-off responders ("the buddy system") and to establish early communications between sites and the command post. Tupras was a unique situation and served to test the innovative powers of the team. Humanitarian needs meant that all available resources were situated within the refinery itself. Self-sufficiency was the only method of oil spill combat. Apart from the assistance of the firefighters, the multiskilled response team had to deal with problems of a nonexistent infrastructure single-handedly.

Although facing tank farm fires and continual tremors, the initial priority was to reduce the flow of oil from the refinery into the sea. Backup and logistical support was sparse as the majority of Tupras workers already had been dedicated to firefighting and humanitarian roles.

The initial OSRL overflight indicated that there was a small amount of visible at-sea pollution. In an attempt to contain any oil, the refinery staff had deployed a continuous air tube skirt boom around the separator outfall. Inspection revealed the boom to be badly damaged, and the response team immediately deployed an additional boom comprising of shore sealing and air tube skirt boom to double up and contain any further oil being freely discharged from the refinery separators. This major release of oil into the bay occurred while the OSRL's duty manager was conducting aerial surveillance of the surrounding area. The oil flowed rapidly through the separator system and eventually through the outfall into the bay.

The OSRL team promptly deployed further containment booms and recovery devices into the separator ponds in an attempt to limit the flow of oil through the outfall (Figure 3). The upset in the interceptor system may have been a result of ruptured pipelines in conjunction with the large amounts of firefighting water coming from the tank farm area. The emphasis was placed on controlling the oil flow within the separator system. The on-scene team quickly operated the weir gates in the separators to lower the water level and to retain the oil. Utilizing temporary storage tanks, oleophillic skimmers, and spate pumps, the situation was quickly stabilized.

Figure 3. Separator recovery operation, Tupras Refinery.

Waste disposal then became an area of concern. The continuing response produced a large quantity of recovered oil and waste requiring disposal facilities urgently. Twenty-four hours passed before the refinery staff identified a vacant tank thatcould be safely utilized for the storage of recovered oil. The separator recovery operation continued around the clock for 48 hours until the equilibrium was reached. By this time, firefighting activities had also been scaled down, thus greatly reducing the flow of water into the separator system.

Emulsified oil was reported to have entered two local coastal harbors, Tavsancil and Karamusel. These harbors were natural collection points on the coastline, and the majority of the oil impacted these sites. Response staff and equipment were deployed there to contain and recover the oil.

Daily overflights continued to indicate estimates of between 200 m^3 and 500 m^3 of oily mass within the water. The recovery operation produced a total 904 m^3 of solid waste, which was returned to the refinery. The 4-day separator operation recovered

over 500 m^3 oil; the 6-day operation at Tavsancil and Karamusel harbors recovered nearly 400 m^3 of emulsified oil; and the beach cleanup operation adjacent the refinery recovered 32 m^3 of beached material.

Lessons learned

The response mobilization and operational activities were accomplished, but not without a number of problems. The lessons learned are as follows:

Disaster planning for petroleum installations is of paramount importance. Consideration should be given to the location, and known geological problems should be identified. Thought needs to be given to various scenarios that include a combination of all eventualities. This particular incident highlighted the need to be able to coordinate many different agencies and contractors (nationally and internationally), all of which have a role to play including firefighting, oil spill control, salvage, and human resources.

Addressing the regional/national coordination of oil spill prevention. Resources that could have proved useful in this response operation were available within southern Turkey. Efforts to obtain these proved extremely difficult, although OSRL accomplished the response on this occasion. A national plan with a mutual support infrastructure to obtain response equipment will greatly aid Turkey in future oil spill responses of this magnitude.

Comprehensive oil spill contingency planning. Had it existed, an oil spill contingency plan would have aided the response team in the decision-making process and management of the incident. Several requests were made to the refinery for information that would normally have been contained within this document. It is still not known what crude oil types were released or had a potential to be released. A contingency plan also would identify a command structure and the relevant designated staff within the refinery management. Environmental sensitivity information also was requested, but not forthcoming, which again would have been included in a contingency plan.

Communications. The telecommunication network failed because of the damage sustained to landlines. The mobile telephone network quickly became overloaded, and portable satellite communication systems proved invaluable. Thought must be given for the provision of several satellite communication systems.

Operational issues encountered. The response mobilization and operational activities were accomplished, but not without a number of problems:

- Breakdown of Turkish telecommunications (mobile and internal systems)
- Total electrical failure within the refinery
- No emergency command structure with the refinery to coordinate firefighting and oil spill activities
- Major disaster—45,000 people presumed killed or missing
- Potential for civil unrest
- Threat of disease (typhoid fever, cholera, and dysentery)
- Continual aftershocks and a serious threat of a second earthquake impacting the area again (responders need to understand the risks of operating in an earthquake area)
- Refinery fire escalating and possibly engulfing the neighboring ammonia and fertilizer plant
- Initially waste disposal routes nonexistent for recovered oil
- Equipment tracking
- No emergency command structure and initially no accommodation for temporary incident command structure
- No oil spill contingency plan or information relating to oil types, refinery management team structure, or environmental sensitivities
- Local weather forecast information difficult to obtain
- Lack of all types of vehicles for responders and transportation of equipment

The above issues gave rise to a total lack of on-site personnel support. This persisted for the initial period of the incident and only improved when the tank farm fires were extinguished and the urgency to save life was reduced.

Once the search and rescue operations diminished, the focus shifted to support available for cleanup operations and support increased. More aid and assistance from the refinery staff also became available as the firefighting effort lessened because of fires being brought under control. Shoreline cleanup activities on the beaches adjacent to the refinery were coordinated by OSRL, but carried out by refinery staff when they became available. All recovered materials were returned to the refinery site for storage and disposal.

It is apparent that OSRL may operate in similar circumstances in the future. With this in mind, attention has been placed on the development and use of a mobile office. The existing communication package certainly is required, particularly the use of satellite communications and hand-portable VHF radios; their use in the earthquake zone proving invaluable.

To maintain optimum team strength in the event of an oil spill callout, the operations group is divided into two teams. The on-call team consists of eleven technicians/senior technicians and one manager. In the event of a callout, the off-call team is used to load and ready the equipment for immediate dispatch to the response location. It is unwise to rely on other organizations to provide the correct amount personal protective equipment of the relevant standard.

In an effort to reduce response times, OSRL has palletized a sizeable portion of its stockpile. The equipment is preloaded into purpose-built aviation platforms (the pallets), which then form an air cargo igloo. The pallets are then placed onto to trailers for quick delivery to an airport and onto the aircraft. These platforms are designed to fit in most commercial freight and scheduled passenger aircraft as belly freight. This greatly reduces the turnaround time for the aircraft on the ground and enables the aircraft to be airborne and en route very quickly. In immediate response operations, including the Tupras Oil Refinery incident, this method of equipment transportation has proved its efficiency and suitability.

Because OSRL is a registered and listed cargo agent, the organization is able to pass response equipment through security controls at airports with ease. The registration allows OSRL to conduct the required preflight security controls and certification of equipment prior to dispatch. All response equipment held at Southampton, Hampshire, United Kingdom is acceptable for direct loading onto any commercial aircraft. Response equipment held at the Southampton base is ready for immediate dispatch and includes the necessary custom documentation for worldwide transportation. OSRL also maintains a closer liaison with a dedicated aircraft broker, which provides the company with a fast track route to an aircraft charter. The broker is on-call 24 hours per day, 365 days per year, and constantly overviews the market and updates the duty manager on a daily basis with the availability of aircraft.

With limited intelligence on Turkey and the possibility of forwarding the equipment to another location within Turkey, it was decided to task the Hercules with the transportation of equipment. The capability of the L382G Hercules for equipment payload, short takeoff and landing capabilities, and the capability to cope with a variety of surface conditioned were recognized.

Conclusion

As responders in Turkey operating in the aftermath of the earthquake disaster, it was found that assistance from suitable local workers, when they were available, was enthusiastic, even when the majority of them had lost relatives and homes in the tragedy. In the future, responders should be mindful of the prevailing culture of the country or region in which they are deployed as this may affect the quality of assistance they may get. In Turkey, and arguably in other developing world countries, people become hardened to the wholesale tragedy of earthquakes, flood, war, and other natural disasters. They are therefore more adaptable to such problems inasmuch as there may be a willingness to actively assist in the cleanup operation, which might not be found so forthcoming in more westernized countries.

Because of the earthquake and damage sustained, Turkey has expected to experience a petroleum product supply shortage. Tupras oil refinery is the largest in the country and suffered a serious amount of damage. During the months since the disaster, an estimated shortage of 350,000 tons of petroleum products is expected resulting in quotas of imported product being permitted in order to meet demand.

Tupras oil refineries acknowledge the potential of a major oil spill incident and called on OSRL as their international aid. The skill base of the team was pushed to extremes throughout its stay in Turkey. With over 904 m of product and waste recovered, this incident demonstrates how assistance from local and even national bodies cannot be relied on, and, without a cross section of skills within a response team, the objective of the task would of not achievable. Prevention and preparation are the key elements to any oil spill incident, and the state-owned Tupras oil company has joined OSRL as a member company. The refinery is running again, although only to 85% of its capacity. Tupras has given consideration to contingency planning, staff training, and equipment audits and is following these processes.

Biography

Tony Harmer is a Response Technician gaining extensive experience as a result of responding to worldwide oil spills: *Sea Empress*, Milford Haven; *Evoikos*, Singapore; *Erika*, France; Texaco, Brazil; and Shell, Portugal. Prior to joining OSRL in 1997, he served 9 years with the Royal Navy in the operations and diving group.